An observational study of the extreme wildfire events of California in 2017 : quantifying the relative importance of climate and weather

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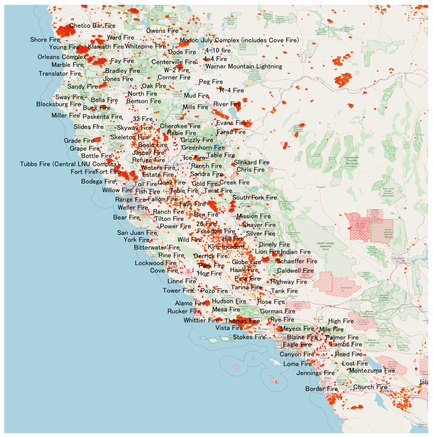
2017 California wildfires



The 2017 fire season in California was the costliest, with 18 Billion US$ in damages, and deadliest with 43 casualties on record

In October, around the Napa valley in Northern California, the Tubbs fire was the most destructive in US history. Warm temperatures and strong winds are thought to be responsible for the severity of these wildfires.

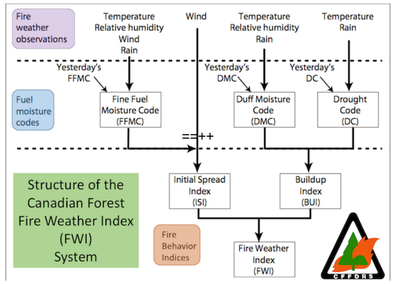
In December, Southern California was plagued by severe wildfires and the Thomas fire near Los Angeles became the largest in California history. It was thought to be fueled by sever Santa Ana winds and warmer than average temperatures.

This works aims to study the important meteorological and climactic factors responsible for the extreme wildfire season of 2017 in California, using the Canadian Fire Weather Index computed from daily values of maximum temperature, minimum relative humidity, wind speed and precipitation computed from RAWS weather stations and ERA-Interim and NARR reanalyses.

(source: https://en.wikipedia.org/wiki/File:2017_California_wildfires_all.png)

Canadian Forest Fire Weather Index (FWI)

The Canadian Fire Weather Index (FWI) is used operationally for short- and medium- term forecasting of fire danger in Canada. It has been adopted by the (European Forest Fire Information System) EFFIS for producing 10-day forecasts of fire danger in Europe. It relies on daily observations of precipitation, temperature, wind and relative humidity at 12h local time. In this study we compute it from daily precipitation and maximum temperature, average wind speed and minimum relative humidity.



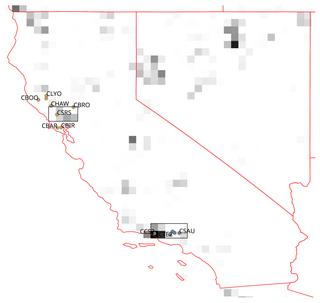
(source: http://www.fbfrg.org/cffdrs/fire-weather-index-fwi-system)

Data Sources

- Burned Area data from the MCD64A1 global burned area product, aggregated at monthly 0.25deg grid.

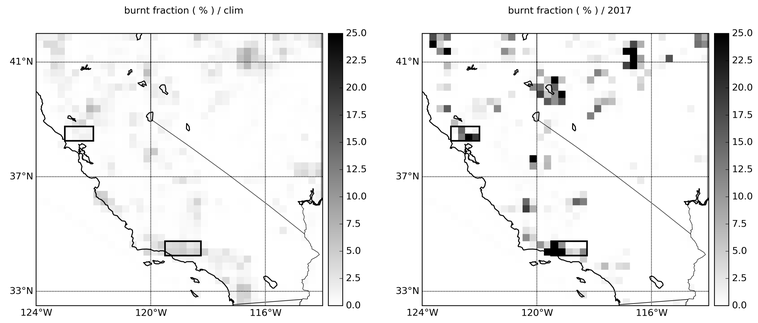
- daily weather data from Remote Automated Weather Stations (RAWS) located in the vicinity of the Tubbs fire (Northern California) e.g. CSRS - Santa Rosa California and Thomas fire (Southern California) e.g. CCS2 - Casitas California

- daily data from the ERA-Interim Reanalysis at native resolution (approx. 80 km) and North American Regional Reanalysis (NARR) interpolated to 0.25 degrees (approx. 30 km).



Overview of the study area showing Burned Area fraction during 2017 from the MCD64A1 burned area product and the RAWS stations used.

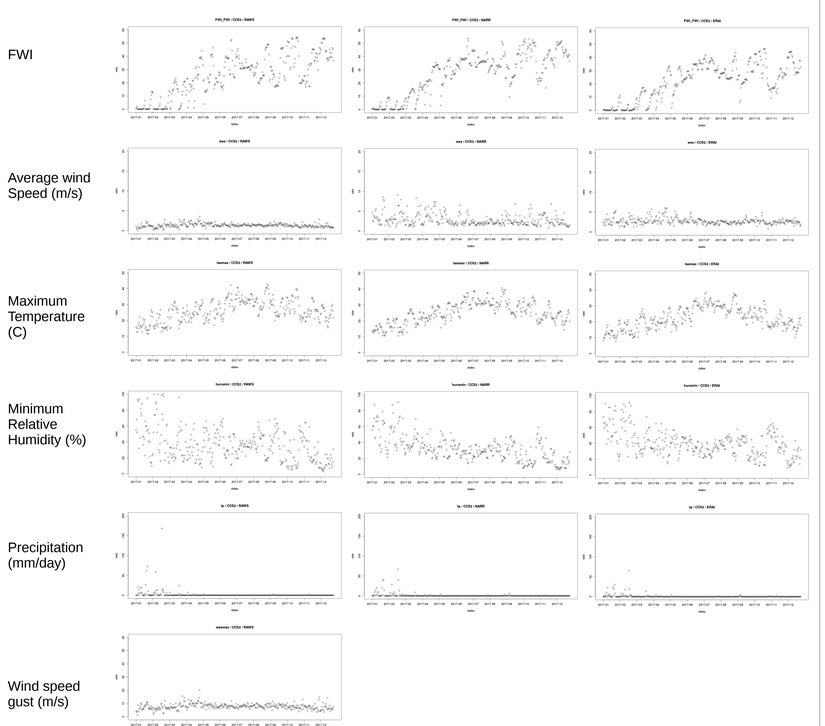
Burned area – 2017 was an extreme year



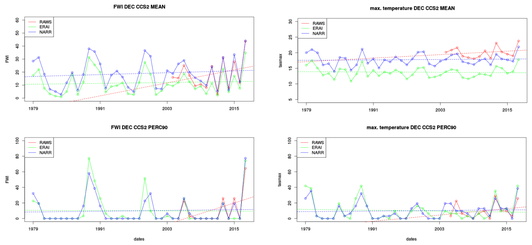
Observed burned areas in 2017 were indeed much higher than climatological averages.

In fact many areas had not been previously burned in the entire MODIS observation period (2000-2017).

Daily data timeseries of CCS2 station for 2017 (RAWS vs. reanalyses)

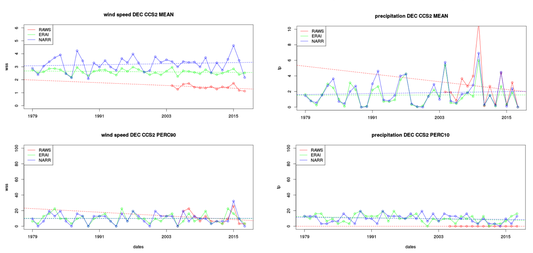


Timeseries of December FWI and meteorological data at station CCS2



In December/2017 station and reanalysis data show that monthly-mean FWI was much higher than average and 80% of days were above the 90th percentile.

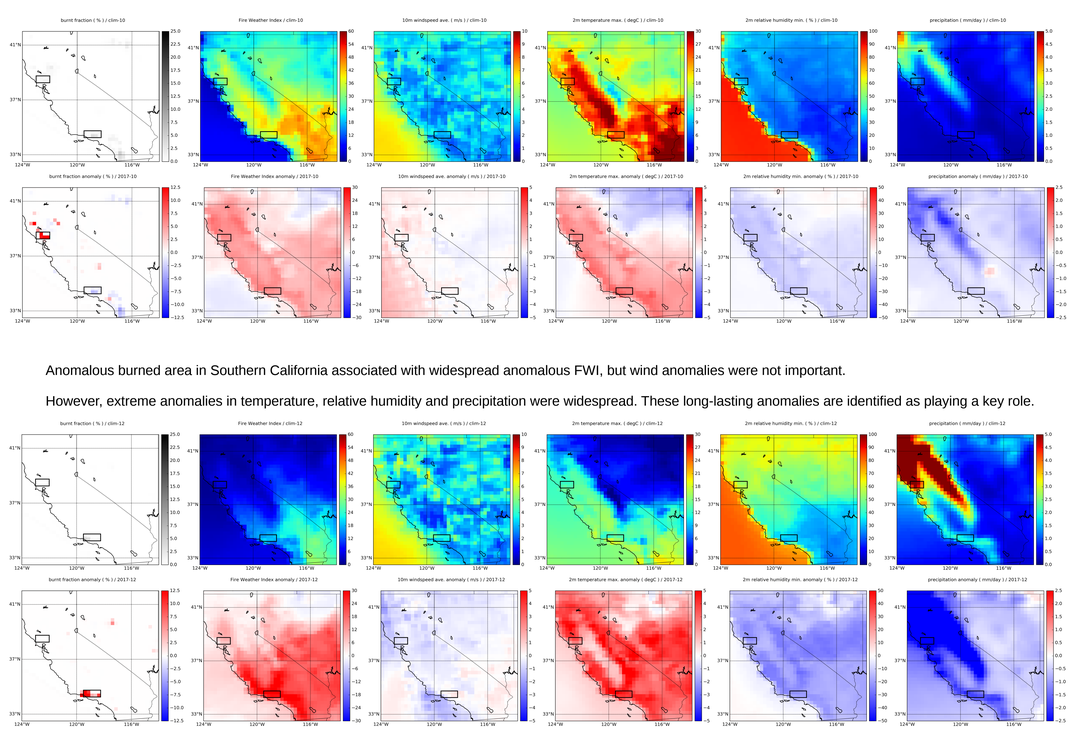
Maximum temperature was also above-average, and a linear trend of 0.05 C/year was detected, which is equivalent to 5C/century. The warming trend could be partially responsible for these extreme conditions (more work is needed).



Despite news reports and statements that Santa Ana winds were exceptionally strong in Decembre/2017 we did not find such evidence in the station data.
In fact there were fewer strong wind events, but timing may be a factor.

Precipitation was below-average and which helped create dryer than average conditions.

Spatial maps of October and December 2017 FWI and meteorological data



Anomalous burned area in Southern California associated with widespread anomalous FWI, but wind anomalies were not important.

However, extreme anomalies in temperature, relative humidity and precipitation were widespread. These long-lasting anomalies are identified as playing a key role.

CONCLUSIONS

- Although the Santa Ana winds were important for fire spread as they fueled the flames, they were not stronger nor more frequent than other years.
- The anomalous warm and dry conditions which persisted for months were key factors in creating the extreme conditions.
- A long-term trend in temperature was detected, further work is require to quantify its relative importance and the likelihood that climate change will favor these conditions in the future.
- Future work : Seasonal prediction of fire risk by predicting frequency of days which extreme FWI a few months ahead, can make authorities aware of extreme conditions and prepare ahead of time. Combined with reliable short-term forecasts this could prevent loss of property and life, such as happened in California and Portugal in 2017.